July 2014 Name ___________________________________

Unit 2 Test

Expectation	Level
C1 - analyse, and propose ways to improve, technologies or procedures that apply principles related to energy and momentum, and assess the social and environmental impact of these technologies or procedures	
C3 - demonstrate an understanding of work, energy, momentum, and the laws of conservation of energy and conservation of momentum, in one and two dimensions	
General Feedback	

Expectation - C3

TRUE/FALSE (level 1)
Please indicate true or false by writing the complete word beside each statement

	Work is done when the force and the displacement are *perpendicular*
	Kinetic energy is a *vector* quantity
	All of the waste energy of a lawn mower is sound
	A system consists of a sliding wooden block on a wooden plank. The plank is mounted on frictionless wheels. Friction causes the block to slow down and stop, so momentum of the system *is not conserved*
	It is *possible* that an object can receive a larger impulse from a small force than from a large force
	Momentum is not conserved in all collisions

Correct any false statements (level 3)

MULTIPLE CHOICE (level 3)
Please indicate the letter of your answer in the column beside each question

	A person picks up a 1.00kg box of macaroni from off the shelf and lowers it 0.77 m into a shopping cart. The work done on the macaroni by Earth is a. 0 J b. 0.77 J c. –0.77 J d. 7.5 J e. –7.5 J

	Which of the following is NOT a unit of energy? a. J d. Nm b. W/s e. kWh c. kgm^2/s^2
	A 102-g sparrow flying at 12.3 m/s wishes to have equal kinetic and gravitational potential energies. The height that will accomplish this is a. 0.315 m d. 1.13 m b. 0.628 m e. 7.72 m c. 0.787 m
	As the mass of a SHM oscillator increases a. the period of vibration increases b. a larger spring constant would be required to prevent a change in the period c. the frequency is inversely proportional to the mass d. two of A, B, and C e. all of A, B, and C
	A woman of mass *M* is at rest on a frictionless skateboard of negligible mass. She throws a cement block of mass *m* with a velocity *v* relative to the ground. After the throw, her velocity relative to the ground is a. $-mv$ d. Mv b. $-\frac{mv}{M+m}$ e. $-\frac{mv}{M}$ c. $\frac{mv}{M}$

SHORT ANSWER (level 3)

1.) Give two observations that would enable you to conclude that the bounce of a superball is not a completely elastic collision. Explain fully.

PROBLEM SOLVING

<u>Question 1</u> (level 2)

Given that $F_c = F_g$ for a satellite, show that the radius of orbit for an Earth satellite is $r_s = \sqrt[3]{\frac{GM_E T_s^2}{4\pi^2}}$

<u>Question 2</u> (level 3)

A 1.5-kg cart rolls along a horizontal table at a constant speed of 1.7 m/s. A ball of soft putty is dropped from a stationary hand onto the cart as it passes underneath. If the speed of the cart is reduced to 0.73 m/s, calculate the mass of the ball of putty.

<u>Question 3</u> (level 4)

A 1.8-kg block, initially at rest, slides down a frictionless ramp that is angled at 35º to the horizontal. At a point 0.45 m down the slope it collides with and sticks to a stationary block of mass 1.1 kg. The blocks then continue another 0.88 m down the ramp. How long does the whole event take? (For those of you wondering how a block is stationary on a frictionless ramp, it was projected up the ramp from below so it had no speed at the time of impact.)

<u>Question 4</u> (level 4)

How much work needs to be done to lift a 5.0×10^2 kg satellite from the surface of the Earth to a height of 200 km above the surface? How fast does the satellite need to be launched from the earth so that it reaches this height before falling back to earth?

<u>Expectation – C1 (level 4 possible)</u>

Answer 3 of the following questions using full paragraphs.

1.) Why is "follow-through" so important for maximizing speeds in sporting activities?

2.) How are principles of energy and momentum used in the design of amusement park rides, such as roller coasters and swing rides?

3.) Why do researchers use crash test dummies in simulated motor vehicle accidents? What impact have innovations such as seat belts and airbags had on injuries resulting from traffic accidents and on the associated health care costs?

4.) What is the environmental impact of the chemicals whose combustion produces the effects in fireworks displays?

Useful Equations

Kinematics

$$v_{av} = \frac{\Delta d}{\Delta t} = \frac{v_1 + v_2}{2}$$ $$a_{av} = \frac{v_2 - v_1}{\Delta t}$$ $$v_2 = v_1 + a\Delta t$$

$$\Delta d = v_1\Delta t + \frac{1}{2}a\Delta t^2$$ $$\Delta d = \frac{(v_1 + v_2)\Delta t}{2}$$ $$\Delta d = v_2\Delta t - \frac{1}{2}a\Delta t^2$$

$$v_2^{\,2} = v_1^{\,2} + 2a\Delta d$$

Dynamics

$$F_g = mg$$ $$F_g = \frac{Gm_1m_2}{\Delta d^2}$$ $$F_f = \mu F_N$$ $$F_{net} = ma$$

$$F = kx$$ $$a_c = \frac{v^2}{r}$$ $$F_c = ma_c = \frac{mv^2}{r}$$ $$\tan\theta = \frac{v^2}{gr}$$

$$g = \frac{GM}{R^2}$$ $$\frac{r^3}{T^2} = \frac{GM}{4\pi^2}$$ $$a_c = \frac{4\pi^2 r}{T^2} = 4\pi^2 rf^2$$

Momentum, Energy & Power

$$W = F\Delta d\cos\theta$$ $$E_g = mgh = -\frac{GMm}{r}$$ $$E_k = \frac{1}{2}mv^2$$

$$E_{elastic} = \frac{1}{2}kx^2$$ $$efficiency = \frac{W_{output}}{W_{input}} \times 100\%$$ $$T = 2\pi\sqrt{\frac{m}{k}}$$

$$P = \frac{W}{\Delta t} = \frac{F\Delta d}{\Delta t} = Fv_{av}$$ $$J = F\Delta t = m\Delta v = \Delta p$$ $$p = mv$$

$$E_{th} = F_f\Delta d$$ $$p = p'$$